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CENTERS FOR DISEASE CONTROL AND PREVENTION NATIONAL CENTER FOR ENVIRONMENTAL HEALTH/AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY ROLES IN HURRICANE RESPONSE AND POSTDISASTER MOSQUITO CONTROL[1]

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Abstract

Hurricanes and other natural disasters leave behind multifaceted and complex environmental challenges that may contribute to adverse health outcomes, such as increased potential for exposure to vector-borne disease. Through an incident management system tailored for the Centers for Disease Control and Prevention (CDC), the National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) fulfills a leadership role in facilitating the agency's natural disaster emergency response activities through coordination with other CDC programs, liaising with other government agencies and impacted jurisdictions, and responding to requests for technical assistance. On the ground, NCEH/ATSDR deploys environmental health (EH) practitioners who provide consultation and inform mosquito control efforts from a systematic perspective. In the wake of recent hurricanes, NCEH staff mobilized to manage critical elements of the responses and to provide assets for addressing environmental hazards and conditions that contributed to the presence of mosquitoes. In this article, we describe NCEH/ATSDR's emergency response roles and responsibilities, interactions within the national emergency response framework, and provision of EH technical assistance and resources, particularly in the context of postdisaster mosquito control.

Keywords

Emergency response; environmental health; hurricanes; mosquitoes

[1]The findings and conclusions in this report are those of the author(s) and do not necessarily represent the official position of the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

INTRODUCTION

Natural disasters such as hurricanes can leave behind multifaceted and complex environmental challenges that could contribute to adverse health outcomes. Federal agencies provide support to state and local agencies in disaster-impacted areas to address these challenges. The blueprint for all federal responses is the Federal Emergency Management Agency (FEMA) National Response Framework (NRF) (FEMA 2016). The NRF assigns specific activities and responsibilities called emergency support functions (ESFs) to federal agencies providing support during emergency responses. Each of the ESFs has a lead and colead agency in charge of support activities; most public health activities during disasters fall under the public health and medical services function (ESF-8). The US Department of Health and Human Services (HHS) Assistant Secretary for Preparedness and Response (ASPR) is the lead agency for ESF-8. All HHS operational divisions, including the Centers for Disease Control and Prevention (CDC), along with other federal agencies, provide the needed support and technical resources during a disaster response.

The HHS/ASPR Incident Management Team (IMT) is the advance element that may be deployed in response to or anticipation of a large or catastrophic event. The initial IMT may include members of several operational divisions from HHS and CDC to establish the beginnings of a federal public health and medical footprint. Their role consists mostly of assessing the scope of damage and evaluating immediate needs to request necessary resources. During large events, HHS and operational divisions provide technical assistance to other federal agencies in their assigned ESFs. For example, CDC may assist FEMA with ESF-6 (mass care, emergency assistance, temporary housing, and human services), which includes disaster shelters and mass feeding operations.

The CDC and its public health professionals play a critical role within the national emergency response framework. The CDC maintains an Emergency Operations Center (EOC) structured according to the incident management system (IMS). The EOC is staffed with public health experts who can identify, monitor, and coordinate support to address most public health threats and emergencies. The EOC operates 24 h a day, 7 days a week (CDC n.d.). When an event requires IMS activation, the activation level can be scaled from 3 to 1 depending on the size and complexity of the required response. Level 1 activation is the highest level for an agency response. In addition, the EOC response can be partially activated or moved to an alternate location if another major response is occurring at the same time. Between the years 2003 and 2012, the CDC supported 55 EOC activations and 109 responses that did not require full EOC activation. Infectious disease-related (29%) and natural disaster-related (28%) responses were the most common types of responses requiring full or partial EOC activation (Leidel et al. 2013).

During responses to natural disasters, CDC’s All Hazards Plan designates CDC’s National Center for Environmental Health/Agency for Toxic Substances and Disease Registry (NCEH/ATSDR) as the lead center for implementing the CDC IMS and directing response and recovery activities. The CDC all hazards plan specifies 3 phases for this type of response: preparedness, response, and recovery. Natural disaster responses require establishment of a scientific response section consisting of several public health technical

task forces, one of which is the Environmental Health (EH) Task Force. The EH Task Force addresses inquiries and tasking related to topics such as water quality, food safety, and vector control (CDC 2018).

The NCEH has been an integral component of CDC's planning and response to emergencies with significant environmental implications including hurricanes; the *Deepwater Horizon* oil spill; the Flint, MI, water crisis; and the Zika virus outbreak. In response to the 2017 Hurricanes Harvey, Irma, and Maria, NCEH/ATSDR supported CDC response activities in multiple US jurisdictions including Texas, Florida, Puerto Rico, and the US Virgin Islands in the EOC and during field deployments with on-the-ground assistance to the affected jurisdictions. The scope and magnitude of these types of responses requires not only close coordination and partnership within CDC among its different centers and programs, but also outside the agency with other federal stakeholders.

Standing water, storm debris, damage to homes and buildings, and disruption of municipal services following disasters can lead to increased mosquito and vector habitat and risk of human–vector interaction. The EH science and practice aims to identify and characterize hazardous agents in the environment (i.e., air, food, and water) and prevent exposures to environmental conditions that are harmful to human health (NEHA 2013). Furthermore, the epidemiologic triangle illustrates how the interactions between agent, host, and environment lead to the spread of illness and injury in a population (Gordis 1996). Effective public health interventions prevent 1 or more interactions between the agent, host, and environment. Environmental Health directly addresses the environment component of the triangle. Considering this role, NCEH/ATSDR focuses on the environmental aspects of vector-borne disease during a response, while closely collaborating with the Division of Vector-Borne Diseases (DVBD) in the National Center for Emerging and Zoonotic Infectious Diseases and other CDC centers and programs focused more on the agent and host components. In the sections below, we describe how NCEH/ATSDR addresses the environmental component and conditions conducive to vectors during emergency responses in the EOC and in the field.

IN THE EMERGENCY OPERATIONS CENTER

Incident management, coordination, and technical consultation

During natural disaster responses, NCEH/ATSDR, through the EH Task Force, coordinates and provides technical assistance in direct communication with state, tribal, local, and territorial public health department EH programs. The EH programs and practitioners, particularly at the local level, are commonly charged with carrying out responsibilities in mosquito and vector control (Ruiz et al. 2018, Gerding et al. 2019). In addition to vector specific coordination, NCEH/ATSDR supports public health department EH programs in a wide range of EH services and activities, such as conducting facility assessments and evaluating water and food safety to identify potential hazards and provide recommendations for correcting deficiencies or addressing unsafe conditions. The NCEH/ATSDR identifies practice-based guidelines and tools for assessments and works with the affected jurisdictions to modify them to fit specific emergency response needs. While not specifically focused on vectors, these assessments contribute to mitigation of root causes for vector presence, population growth, and human–vector interaction.

The CDC EH Task Force serves as a liaison between the field response, IMS leadership, and external partners. In 2017, the EH Task Force provided support to multiple jurisdictions impacted by Hurricanes Harvey, Irma, and Maria by gathering information on vector control activities and concerns from the affected areas and reporting to both IMS leadership and partners. The information sharing between the affected jurisdictions and EOC leadership assisted with the identification of relevant vector issues and provision of guidance, along with informing needs for vector control resources for both short- and long-term mosquito control, including both larval and adult populations. Additionally, the EH Task Force worked with the IMS/CDC Joint Information Center to tailor existing messaging and guidance on vector-borne disease risk and pesticide use to meet the needs of affected jurisdictions. During responses, the EH Task Force reviews vector-related inquiries from jurisdictions and public health professionals and coordinates with subject matter experts throughout the CDC to provide comprehensive, timely, and accurate responses.

IN THE FIELD

Environmental health practice and technical assistance

The NCEH/ATSDR's field support to disaster-affected jurisdictions is characterized as addressing the root causes of vector presence through EH assessments and assisting with the implementation of integrated pest management (IPM) strategies. Postdisaster jurisdictions may face damage to infrastructure, displaced personnel, and competition for resources. At the request of affected jurisdictions, NCEH/ATSDR deploys EH practitioners to provide direct technical assistance and supplement field capacity to address disaster-related needs. Vector control technical assistance requests, questions, and responses are managed by the CDC EH Task Force. Responses and deployments are coordinated with DVBD entomologists and vector control subject matter experts, who are often deployed to provide consultation on mosquito control aspects, including adulticiding and laviciding activities. As an aspect of this technical assistance, NCEH/ATSDR emphasizes the application of IPM and employing a variety of pest management techniques that focus on pest prevention, pest reduction, and the elimination of conditions that lead to pest infestations (CDC 2010). The EH practitioners consider a systematic approach for controlling and preventing exposures to environmental hazards. In terms of vector and mosquito control, this approach complements chemical control methods by assessing and addressing environmental factors including wastewater disposal and removal of solid waste and debris as root causes that could contribute to vector presence and create harborage areas.

In response to the 2017 hurricanes, NCEH/ATSDR supported efforts to identify and minimize favorable mosquito and other vector habitats through the assessments of facilities such as disaster shelters and provided technical assistance to the US Virgin Islands Department of Health (VIDOH) for 2 Community Assessments for Public Health Emergency Response (CASPER) related to mosquito control (Schnall et al. 2019). The CDC Shelter Assessment Tool exemplifies the type of comprehensive assessment EH practitioners conduct to evaluate a wide range of environmental factors with bearing on vector presence, such as waste management and integrity of doors, windows, and screens for excluding entry of mosquitoes and other vectors, including rodents (CDC 2008). In addition to shelter

assessments, NCEH/ATSDR supported assessment of damaged water cisterns as potential mosquito breeding sites, provided jurisdictions with guidance on larvicide application, and identified habitats suitable for vector harborage due to poststorm infrastructure damage and debris. After Hurricanes Irma and Maria in the US Virgin Islands, NCEH/ATSDR provided boots on the ground and technical assistance using the CDC-designed CASPER Toolkit. The CASPERs are important tools used to gather household level information about a community. These assessments were designed to rapidly assess the community's experience and attitudes regarding mosquito control during the response and recovery phases. The VIDOH used the information gathered from these assessments to inform and prioritize mosquito control messaging and activities (Seger et al. 2019).

In conclusion, as the lead CDC center, NCEH/ATSDR provides programmatic support when requested to affected areas by facilitating coordination between affected jurisdictions, CDC's leadership and subject matter experts, and external partners. The NCEH/ATSDR offers and supports direct field assistance at the request of affected jurisdictions through the deployment of EH practitioners. During deployment, EH practitioners play a vital role identifying and assessing environmental conditions conducive to vectors and pests. During the 2017 hurricane response, NCEH/ATSDR assisted impacted jurisdictions with conducting comprehensive EH activities including facility assessments, while emphasizing IPM strategies to address root causes of vector and pest population growth and limit the potential for human–vector interaction.

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